MAU

Medium Attachment Unit
Installation Manual

BNC MAU
TP MAU
FO MAU
Ethernet Medium Attachment Unit
Installation Manual

This manual contains reference information to aid in the installation and operation of the "thin" Ethernet MAU (BNC MAU), twisted pair Ethernet MAU (TP MAU) and fiber optic Ethernet MAU (FO MAU).

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Chapter 1
Introduction to Medium Attachment Units

Medium Attachment Unit (MAU) is defined in the IEEE 802.3 (ISO/IEC 8802-3) standard specifications as a device used to connect what the IEEE calls a DTE (Data Terminal Equipment, usually a PC or other computer with an Ethernet adapter of some kind), to the network transmission medium (the LAN cable). MAUs are also called *transceivers* in accordance with current general usage within the networking industry.

IEEE 802.3 specifications now allow the use of twisted pair and fiber optic cable, in addition to traditional coaxial. IMC Networks manufactures MAUs for each type of cabling.

One end of the MAU connects to the AUI (Attachment Unit Interface) port on a DTE. The AUI is the female DB-15 connector found on most

Ethernet-compatible computers, terminals and Ethernet network interface cards.

On the other end of the MAU is a connection to the network cable itself. With IEEE 802.3 (ISO/IEC 8802-3) 10BASE2 "thin" Ethernet cable, this is a female BNC connector (BNC MAU). With 10BASET twisted pair cable, this is a single RJ-45 connector (TP MAU). With Fiber Optic Inter Repeater Link (FOIRL) cable, this is two ST connectors, one for transmit and one for receive (FO MAU). (SMA fiber optic connectors are also available on a special-order basis.)

This means that with the proper MAUs, virtually any Ethernet terminal, computer, or other device can be connected into an Ethernet LAN regardless of the cabling topology used. With MAUs, equipment which may have been designed without allowance for "thin" coaxial, twisted pair or fiber optic cabling systems can be integrated into new multi-media networks easily, inexpensively and in full compliance with existing standards.

Chapter 2
Common Features and Settings

Except for the support of different cable types, all IMC Networks MAUs are very similar in design and functionality. Common features include:

- Full compliance with the IEEE 802.3 (ISO/IEC 8802-3) specifications, including the 10BASE2 (BNC MAU), 10BASET (TP MAU) and FOIRL (FO MAU) subsections.
- Compact size (5.99 cm x 4.45 cm x 1.91 cm) allows MAUs to be attached directly to AUI ports, eliminating the need for costly and cumbersome AUI cables.
- Power is supplied to the MAUs via the AUI ports, eliminating the need for external power supplies.
- 2-year warranty to the end user.

LEDs

All MAUs have six LEDs for troubleshooting and monitoring connection status. Note that problems indicated by the LEDs may be network-wide if multiple MAUs on the LAN exhibit the same error conditions.

The LEDs on the TP MAU and FO MAU are illustrated in Figure 2.1 and the following describes the function, labelling and color for each LED. Some versions of TP MAU and FO MAU have the LEDs on the reverse side of the MAU. Functionally, there is no difference.

Collision (COL)	Glows red when collisions are detected on the LAN.
Link (LNK)	Glows green if a good connection has been established (see discussions on Link Integrity and Low Light in Chapters 4 and 5 respectively).

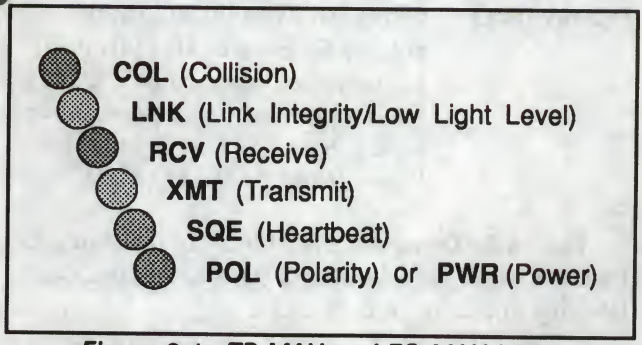

Figure 2.1. TP MAU and FO MAU LEDs

Receive (**RCV**)	Glows amber when packets are received. Should flash simultaneously with **XMT** LED.
Transmit (**XMT**)	Glows green when packets are transmitted. Should flash simultaneously with **RCV** LED.
Heartbeat (**SQE**)	Glows amber when **SQE** is enabled (see *Heartbeat* (**SQE**) *Test Switch* in this chapter).

Polarity (POL) — Glows red when the automatic polarity fix feature (TP MAU only) has corrected reversed polarity in the *receive* twisted pair wires in the cable. Note: This LED indicates Power (PWR) on the FO MAU.

The six LEDs on the BNC MAU are illustrated in Figure 2.2 and the following describes the function, labelling and color of each LED.

Termination (TERM) — Glows green when the onboard termination is enabled (see Chapter 3, *Termination Switch*).

93 Ohm Cable (93 Ω) — Glows green when 93 Ohm (RG-62) cable is selected*.

75 Ohm Cable (75 Ω) — Glows green when 75 Ohm (RG-59) cable is selected*.

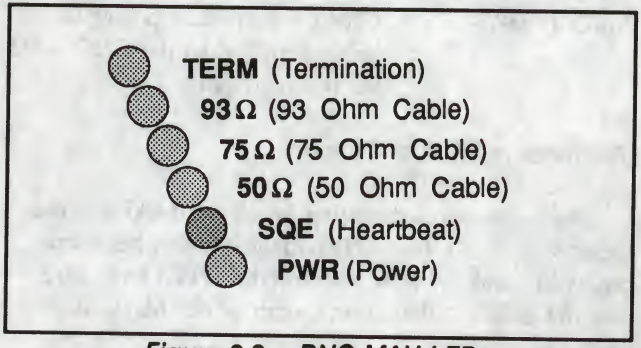

Figure 2.2. BNC MAU LEDs

50 Ohm Cable (**50 Ω**)	Glows green when 50 Ohm (RG-58) cable is selected*.
Heartbeat (**SQE**)	Glows amber when (**SQE**) is enabled (See *Heartbeat* (**SQE**) *Test Switch* in this chapter).

* Refer to Chapter 3, Coaxial Cable Impedance Selection for further discussion of this unique capability.

Power (PWR)	Glows green when power is being supplied to the BNC MAU via the AUI port.

Heartbeat (SQE) Test Switch

The only common setting on all the MAUs is the Heartbeat (SQE) Test. Heartbeat is a test between the MAU and the host system (the DTE) to ensure that the collision detection circuit in the MAU is working.

The heartbeat function is *enabled* at the factory. If the MAU is connected to a hub or a repeater, the Heartbeat Test must be disabled.

To *disable* the Heartbeat Test, use the small screwdriver supplied with the MAU and rotate the SQE switch *clockwise* to the OFF position. The SQE LED will not glow. To *re-enable* the Heartbeat Test, rotate the SQE switch *counter-clockwise* to the ON position (Figure 2.3). When the Heartbeat Test is

enabled, the amber **SQE** LED will glow continuously when attached to an active host system.

In most cases, it is best to leave the Heartbeat Test *enabled*, the factory default condition.

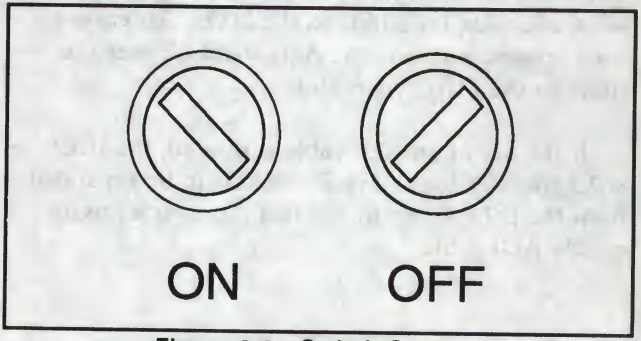

Figure 2.3. Switch Settings

Other Switches

Additional switch settings (**LINK**, **TERM**, etc.) are discussed in Chapters 3 and 4.

AUI Connection

All IMC Networks MAUs are small enough to be attached directly to the AUI port on the DTE device. Because the pins on the male DB-15 connector on the MAU can be damaged by rough handling, use care when attaching the MAU to the DTE. To ensure a good connection, slide the AUI slidelock over the studs on the MAU connector.

If the use of an AUI cable is desired, the IEEE 802.3 specifications allow for MAUs to be separated from the DTE by up to 164 feet (50 meters) using quality AUI cable.

Chapter 3
BNC MAU Configuration

BNC MAU conforms to the IEEE 802.3 10BASE5 and 10BASE2 standards for using Ethernet over "thick" and "thin" coaxial cable. BNC MAUs are compatible with other third-party IEEE 802.3 Ethernet products and can be integrated easily into existing network systems.

Termination Switch

Onboard segment termination on the BNC port is controlled by an external switch on the BNC MAU (Figure 3.1).

If an Ethernet segment is to be terminated at the BNC MAU, plug the cable directly into the BNC port with the termination switch in the ON (enabled) position.

If the BNC MAU is attached to a midpoint of a "thin" Ethernet segment, attach a "T" connector to the BNC port and set the termination switch to the **OFF** (disabled) position (the factory default).

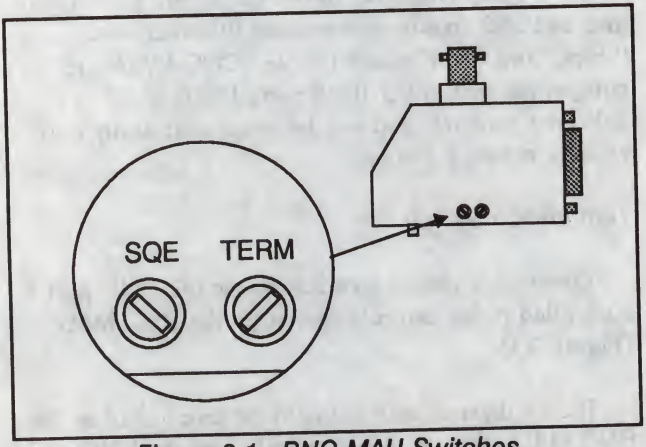

Figure 3.1. BNC MAU Switches

When onboard termination is *enabled*, the green **TERM** LED will glow continuously. To *disable*

onboard termination, use the small screwdriver supplied with the MAU and rotate the **TERM** switch *clockwise* to the **OFF** position. The **TERM** LED will not glow. To *re-enable* onboard termination, rotate the **TERM** switch *counter-clockwise* to the **ON** position.

"Thin" Ethernet Cabling

The IEEE 802.3 10BASE2 specification calls for the use of 50 Ohm (RG-58) cabling. Under the specification, up to 30 devices may be attached on a single segment, and the maximum segment length is 607 feet (185 meters).

Many manufacturers, including IMC Networks, support the use of up to 1,000 feet (305 meters) of cable on a single segment.

Coaxial Cabling Impedance Selection

One of the most unique and powerful features of the BNC MAU, as with all IMC Networks products

with a BNC connector, is the capability of optionally running Ethernet over 75 Ohm and 93 Ohm coaxial cable in addition to the Ethernet standard of 50 Ohm.

This allows BNC MAU to be installed in sites already cabled with 93 Ohm coaxial cable, such as IBM 3270 and ARCnet, as well as sites previously cabled with 75 Ohm cable for G/Net, PCnet or Wang word processing systems.

A comprehensive document titled *Ethernet LANs Using Non-Ethernet Cabling* is available upon request, at no charge, from IMC Networks.

Cabling Impedance Selection Switch

The BNC MAU factory default setting is for standard 50 Ohm "thin" Ethernet cabling, but different cable impedances may be easily selected. On the bottom of the BNC MAU is a three position slide switch (Figure 3.2). This switch controls both the cable impedance and corresponding port termination value when onboard termination is enabled.

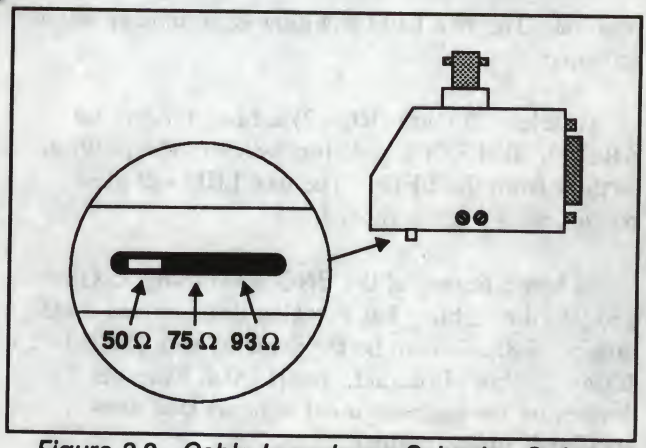

Figure 3.2. Cable Impedance Selection Switch

In the factory default setting for 50 Ohm cabling, the switch is set in the position closest to the LEDs. When the BNC MAU is active in this mode, the **50 Ω** LED will glow continuously.

To select 75 Ohm (RG-59) cabling (converted PCnet, G/Net), slide the switch to the middle

position. The 75 Ω LED will glow continuously when activated.

To select 93 Ohm (RG-62) cabling (converted ARCnet, IBM 3270), slide the switch to the position farthest from the LEDs. The 93 Ω LED will glow continuously when activated.

In-house testing of the BNC MAU using 75 Ohm and 93 Ohm cabling has revealed distance and node-number limitations to be the same as with IEEE 802.3 10BASE2 "thin" Ethernet. **Note: ALL Ethernet devices on the segment must support this non-standard cabling feature.**

Chapter 4
TP MAU Configuration

TP MAU conforms to the IEEE 802.3 10BASE5 and 10BASET standards for using Ethernet over "thick" coaxial and unshielded twisted pair cable. TP MAUs are compatible with other third-party IEEE 802.3 Ethernet products and can be integrated easily into existing network systems.

Link Integrity Test Selection

The IEEE 802.3 10BASET standard for twisted pair Ethernet requires that all compatible devices maintain a constant *link integrity test* signal between the hub and the MAU. Link integrity test may also be called *link integrity check*, *link pulse* or *linkbeat*, and is used by IEEE 802.3 10BASET devices to ensure the integrity of the twisted pair cable connection between the hub and the MAU.

In support of the IEEE 802.3 10BASET standard, TP MAU features continuous link integrity testing in its factory default configuration. However, there are some twisted pair hubs in the field which support draft versions of the IEEE 802.3 10BASET standard where link integrity test was not specified. To support these, link integrity test can be disabled on the TP MAU.

To disable link integrity test, use the small screwdriver supplied with the TP MAU to rotate the LINK switch *clockwise* to the **OFF** position (Figures 2.3, 4.1). Note: When link integrity test is disabled, the green LNK LED will glow continuously, whether or not a twisted pair link has been established.

To re-enable link integrity test, rotate the LINK switch *counter-clockwise* to the **ON** position. In this mode, the green LNK LED will glow continuously only when a twisted pair link has been established with an operational 10BASET hub.

In most cases, it is best to leave link integrity test *enabled*, the factory default condition.

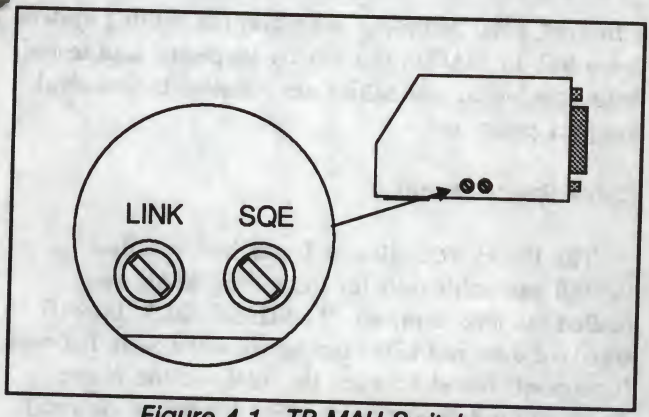

Figure 4.1. TP MAU Switches

Twisted Pair Ethernet Cabling

Twisted pair Ethernet systems are unusually sensitive to improper cabling. High quality wire and connectors must be combined into a cabling system meeting or exceeding IEEE 802.3 10BASET standard specifications. Because cabling problems are by far the most common associated with twisted pair

Ethernet, IMC Networks asks that the cabling system from hub to MAU is thoroughly inspected and tested before technical difficulties are referred to technical support personnel.

Cable Specifications

The IEEE 802.3 10BASET standard specifies twisted pair cable *only* for the hub-to-MAU run (called the *link segment*). The IEEE 802.3 10BASET standard **does not** allow the use of silver satin flat wire (commonly found between the wall and the phone device in modular home or office telephone systems), straight patch wires, or any other cable which is not comprised of at least two twisted copper pairs.

The recommended twisted pair wire for the link segment is a 100 Ohm unshielded 24 AWG wire, such as AT&T Type D inside wire (DIW) or an equivalent. DIW is available in several sizes, 3, 4, 6, 12, 16, and 25 pairs. It is sheathed in a grey or beige jacket of any of several different materials, depending upon local

building codes, and each wire pair has a characteristic color code.

When using the proper cabling, IEEE 802.3 10BASET supports link segment distances of up to 328 feet (100 meters).

Consult the manual which came with the 10BASET hub and/or the IEEE 802.3 10BASET specifications for more information about twisted pair cabling.

Connectors

The IEEE 802.3 10BASET standard specifies that the link segment terminate at the MAU with a male 8-pin RJ-45 (ISO 8877) modular connector. **This is different from the 6-pin RJ-11 connector commonly used in telephone applications.** The corresponding female connector is defined for use at the medium dependent interface (MDI) on the MAU itself and is also used on many IEEE 802.3 10BASET hubs.

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Chapter 5
FO MAU Configuration

FO MAU conforms to the IEEE 802.3 10BASE5 and Fiber Optic Inter Repeater Link (FOIRL) standards for incorporating fiber optic cables into Ethernet LANs. FO MAUs are compatible with other third-party IEEE 802.3 Ethernet products and can be integrated easily into existing network systems.

The IEEE 802.3 FOIRL standard only describes a method for connecting fiber optic repeaters. However, the FOIRL specifications have been used by IMC Networks and other vendors to produce FOIRL network interface cards and MAUs.

Fiber Optic Ethernet Cabling

Thanks to the widespread acceptance of industry standard fiber optic cable and connector specifications, installing FOIRL networks can, with careful planning, be easier than using more traditional cabling schemes.

Because digital signals transmitted over unbroken lengths of fiber optic cable are completely immune to RF interference, little regard needs to be given to avoiding electronically noisy environments when planning the cable installation. Also, FOIRL supports cable lengths which would require the use of repeaters or bridges with coaxial cable.

Fiber optic cable splicing requires costly splicing equipment used by trained personnel. For this reason, IMC Networks recommends that professionals experienced with fiber optic LANs be consulted in the planning and installation of FOIRL networks.

FOIRL Cable Specifications

The IEEE 802.3 FOIRL specification requires that the cable segment, *as installed* (including splices, etc.), has an attenuation (weakening of signal) less than or equal to 10 dB/km and a bandwidth greater than or equal to 150 Mhz (referred to 1 km at a wavelength of 850 nm).

Fortunately, the market has responded with standard fiber optic cable types, and the following gauges are compatible with FOIRL and FO MAU:

50/125 μm
62.5/125 μm (most common)
85/125 μm
100/140 μm

Though it is not required, duplex cable is recommended to make installation and maintenance easier and more convenient.

The only cabling consideration is to ensure that the resulting FOIRL segments meet the above attenuation specifications, using specialized fiber optic measuring and test equipment. This is easier to accomplish when splices are reduced to a minimum.

Connectors

The FO MAU features standard ST-type bayonet-mount connectors, so pre-measured fiber optic cable lengths should be ordered with this connector.

Fiber optic cable, which may already be installed in the walls of a building, may require the use of SMA-type screw-on connectors. In this case, FO MAUs with SMA connectors can be special-ordered from IMC Networks.

FOIRL Link Segment Specifications

As with IEEE 802.3 10BASET LANs, the cable run between two FOIRL devices is called a *link segment*. The IEEE 802.3 FOIRL specification allows link segments of up to 1 km (1,000 meters, or 3,280 feet) in most instances.

Consult the manual which came with the FOIRL hub and/or the IEEE 802.3 FOIRL specifications for more information about fiber optic cabling.

Cabling the FOIRL Link Segment

The cabling of the FOIRL link segment is very simple. The *receive* connector on the FO MAU is

labelled **RCV** and the *transmit* connector is labelled **XMT** (Figure 5.1). FO MAU is connected to a fiber optic hub by running a fiber optic cable from the transmit connector on FO MAU to the receive connector on the hub, and vice versa. This is simplified using duplex cable, where one of the pair of cables is marked along its length.

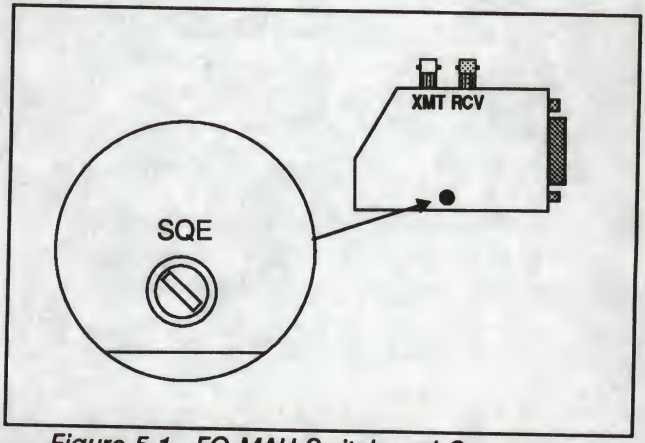

Figure 5.1. FO MAU Switch and Connectors

Once the FO MAU is successfully connected to a hub and both devices powered on, the green LNK LED should glow. The LNK LED acts as a link integrity check and a low light indicator. If it should go out, a physical problem with the fiber optic link segment is indicated.

Chapter 6
Electronic Remote Bulletin Board System

IMC Networks has established an Electronic Remote Bulletin Board System (RBBS) to assist in customer support.

The IMC Electronic InfoCenter contains copies of the latest drivers and software revisions for IMC Networks products, complete text for Technical Bulletins, product marketing information for IMC products and U.S. list price schedules. A quick reference guide to using the InfoCenter is available for downloading as file RBBS-PC.QRF.

The IMC InfoCenter uses a Telebit T3000 modem with V.32 V.42bis support for 300, 1200, 2400, 4800, and 9600 baud access and up to 38,400 baud file transfer speed with V.42bis data compression.

To use the InfoCenter, set your modem to 8 data bits, 1 stop bit, and no parity at up to 9600 baud. The

IMC Electronic InfoCenter is available 24 hours per day, 7 days per week at 714/724-0930.

Technical Support

If problems persist with the MAUs, please re-check the configuration, then call your local distributor/dealer or IMC Networks Corp. Technical Support (in the US: 800/624-1070; outside the US: 714/724-1070; FAX: 714/724-1020).

Please have the following information ready when calling:

The product name
A description of the problem
A list of the corrective actions already taken

Technical Support is available from 8:00 A.M. to 5:00 P.M. Monday through Friday, Pacific Standard/Daylight Time (PST/PDT).

Chapter 7
Warranty

IMC Networks Corp. warrants to the original end-user purchaser that this product, EXCLUSIVE OF SOFTWARE, shall be free from defects in materials and workmanship under normal and proper use in accordance with IMC Networks' instructions and directions for the periods listed below after the original date of purchase:

Network Interface Cards	5 Years
Repeater Products	2 Years
MAUs	2 Years

This warranty is subject to the limitations set forth below.

At its option, IMC Networks will repair or replace at no charge the IMC Networks product which proves to be defective within such warranty period. This limited warranty shall not apply if the IMC Networks product has been damaged by unreasonable use,

accident, negligence, service or modification by anyone other than an authorized IMC Networks Service Technician or by any other causes unrelated to defective materials or workmanship. Any replaced or repaired products or parts carry a ninety (90) day warranty or the remainder of the initial warranty period, whichever is longer.

To receive in-warranty service, the defective product must be received at IMC Networks no later than the end of the warranty period. The product must be accompanied by proof of purchase, satisfactory to IMC Networks, denoting product serial number and purchase date, a written description of the defect and a Return Merchandise Authorization (RMA) number issued by IMC Networks. No products will be accepted by IMC Networks which do not have an RMA number. For an RMA number, contact IMC Networks at PHONE: (714) 724-1070 or FAX: (714) 724-1020. The end-user shall return the defective product to IMC Networks, freight, customs and handling charges prepaid. End-user agrees to accept all liability for loss of or damages to the

returned product during shipment. IMC Networks shall repair or replace the returned product, at its option, and return the repaired or new product to the end-user, freight prepaid, via method to be determined by IMC Networks.

IMC Networks shall not be liable for any costs of procurement of substitute goods, loss of profits, or any incidental, consequential, and/or special damages of any kind resulting from a breach of any applicable express or implied warranty, breach of any obligation arising from breach of warranty, or otherwise with respect to the manufacture and sale of any IMC Networks product, whether or not IMC Networks has been advised of the possibility of such loss or damage.

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FCC Compliance Statement

These devices comply with Part 15 of the FCC Rules. Operation of these devices is subject to the following two conditions: (1) These devices may not cause harmful interference and (2) These devices must accept any interference received, including interference that may cause undesired operation.

FCC Warning Statement

Note: This equipment has been tested and found to comply with the limits for a Class A computing device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is

likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The use of non-shielded I/O cables may not guarantee compliance with FCC RFI limits.

IMC Networks Corp.